

Introduction to Database Systems CSE 414

Lecture 3: SQL Basics

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Review

- Relational data model
 - Schema + instance + query language
- Query language: SQL
 - Create tables
 - Retrieve records from tables
 - Declare keys and foreign keys

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Discussion

- Tables are NOT ordered
 - they are sets or multisets (bags)
- Tables are FLAT
 - No nested attributes
- Tables DO NOT prescribe how they are implemented / stored on disk
 - This is called **physical data independence**

recall: ABSTRACTION from 143

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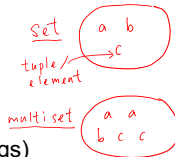


Table Implementation

- How would you implement this?

cname	country	no_employees	for_profit
GizmoWorks	USA	20000	True
Canon	Japan	50000	True
Hitachi	Japan	30000	True
HappyCam	Canada	500	False

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Table Implementation

- How would you implement this?

cname	country	no_employees	for_profit
GizmoWorks	USA	20000	True
Canon	Japan	50000	True
Hitachi	Japan	30000	True
HappyCam	Canada	500	False

Row major: as an array of objects

GizmoWorks	Canon	Hitachi	HappyCam
USA	Japan	Japan	Canada
20000	50000	30000	500
True	True	True	False

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Table Implementation

- How would you implement this?

cname	country	no_employees	for_profit
GizmoWorks	USA	20000	True
Canon	Japan	50000	True
Hitachi	Japan	30000	True
HappyCam	Canada	500	False

Column major: as one array per attribute

GizmoWorks	Canon	Hitachi	HappyCam
USA	Japan	Japan	Canada
20000	50000	30000	500
True	True	True	False

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Table Implementation

- How would you implement this?

cname	country	no_employees	for_profit
GizmoWorks	USA	20000	True
Canon	Japan	50000	True
Hitachi	Japan	30000	True
HappyCam	Canada	500	False

Physical data independence

The logical definition of the data remains unchanged, even when we make changes to the actual implementation

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First Normal Form

cname	country	no_employees	for_profit
Canon	Japan	50000	Y
Hitachi	Japan	30000	Y

- All relations must be flat: we say that the relation is in *first normal form*

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First Normal Form

cname	country	no_employees	for_profit
Canon	Japan	50000	Y
Hitachi	Japan	30000	Y

- All relations must be flat: we say that the relation is in *first normal form*
- E.g., we want to add products manufactured by each company:

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First Normal Form

cname	country	no_employees	for_profit
Canon	Japan	50000	Y
Hitachi	Japan	30000	Y

- All relations must be flat: we say that the relation is in *first normal form*
- E.g., we want to add products manufactured by each company:

cname	country	no_employees	for_profit	products									
Canon	Japan	50000	Y	<table border="1"> <thead> <tr> <th>pname</th> <th>price</th> <th>category</th> </tr> </thead> <tbody> <tr> <td>SingleTouch</td> <td>149.99</td> <td>Photography</td> </tr> <tr> <td>Gadget</td> <td>200</td> <td>Toy</td> </tr> </tbody> </table>	pname	price	category	SingleTouch	149.99	Photography	Gadget	200	Toy
pname	price	category											
SingleTouch	149.99	Photography											
Gadget	200	Toy											
Hitachi	Japan	30000	Y	<table border="1"> <thead> <tr> <th>pname</th> <th>price</th> <th>category</th> </tr> </thead> <tbody> <tr> <td>AC</td> <td>300</td> <td>Appliance</td> </tr> </tbody> </table>	pname	price	category	AC	300	Appliance			
pname	price	category											
AC	300	Appliance											

First Normal Form

cname	country	no_employees	for_profit
Canon	Japan	50000	Y
Hitachi	Japan	30000	Y

- All relations must be flat: we say that the relation is in *first normal form*
- E.g., we want to add products manufactured by each company:

Non-1NF!

cname	country	no_employees	for_profit	products									
Canon	Japan	50000	Y	<table border="1"> <thead> <tr> <th>pname</th> <th>price</th> <th>category</th> </tr> </thead> <tbody> <tr> <td>SingleTouch</td> <td>149.99</td> <td>Photography</td> </tr> <tr> <td>Gadget</td> <td>200</td> <td>Toy</td> </tr> </tbody> </table>	pname	price	category	SingleTouch	149.99	Photography	Gadget	200	Toy
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pname	price	category											
AC	300	Appliance											

First Normal Form

We will learn how different languages and data models handle this aspect

Now it's in 1NF

Company

cname	country	no_employees	for_profit
Canon	Japan	50000	Y
Hitachi	Japan	30000	Y

Products

pname	price	category	manufacturer
SingleTouch	149.99	Photography	Canon
AC	300	Appliance	Hitachi
Gadget	200	Toy	Canon

Foreign Key

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SQL

- **Structured Query Language**
- Most widely used language to query relational data
- One of the many languages for querying relational data
- A **declarative programming language**

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Selections in SQL

```
SELECT *
FROM Product
WHERE price > 100.0
```

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Demo 2

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Product(pname, price, category, manufacturer)
Company(cname, country)

Joins in SQL

pname	price	category	manufacturer	cname	country
MultiTouch	199.99	gadget	Canon	GizmoWorks	USA
SingleTouch	49.99	photography	Canon	Canon	Japan
Gizom	50	gadget	GizmoWorks	Hitachi	Japan
SuperGizmo	250.00	gadget	GizmoWorks		

Retrieve all Japanese products that cost < \$150

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Product(pname, price, category, manufacturer)
Company(cname, country)

Joins in SQL

pname	price	category	manufacturer	cname	country
MultiTouch	199.99	gadget	Canon	GizmoWorks	USA
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Gizom	50	gadget	GizmoWorks	Hitachi	Japan
SuperGizmo	250.00	gadget	GizmoWorks		

Retrieve all Japanese products that cost < \$150

```
SELECT pname, price
FROM Product, Company
WHERE ...
```

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Product(pname, price, category, manufacturer)
Company(cname, country)

Joins in SQL

pname	price	category	manufacturer	cname	country
MultiTouch	199.99	gadget	Canon	GizmoWorks	USA
SingleTouch	49.99	photography	Canon	Canon	Japan
Gizom	50	gadget	GizmoWorks	Hitachi	Japan
SuperGizmo	250.00	gadget	GizmoWorks		

Retrieve all Japanese products that cost < \$150

```
SELECT P.pname, C.price
FROM Product as P, Company as C
WHERE P.manufacturer=C.cname AND
      P.country='Japan' AND C.price < 150
```

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Join Predicate
Selection predicates

Product(pname, price, category, manufacturer)
 Company(cname, country)

Joins in SQL

pname	price	category	manufacturer	cname	country
MultiTouch	199.99	gadget	Canon	GizmoWorks	USA
SingleTouch	49.99	photography	Canon	Canon	Japan
Gizom	50	gadget	GizmoWorks	Hitachi	Japan
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Retrieve all USA companies
that manufacture "gadget" products

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Product(pname, price, category, manufacturer)
 Company(cname, country)

Joins in SQL

pname	price	category	manufacturer	cname	country
MultiTouch	199.99	gadget	Canon	GizmoWorks	USA
SingleTouch	49.99	photography	Canon	Canon	Japan
Gizom	50	gadget	GizmoWorks	Hitachi	Japan
SuperGizmo	250.00	gadget	GizmoWorks		

Retrieve all USA companies
that manufacture "gadget" products

```
SELECT DISTINCT cname
FROM Product, Company
WHERE country='USA' AND category = 'gadget'
AND manufacturer = cname
```

Why
DISTINCT?